

# NXP Radio Power Solutions

## Enabling the 5G Revolution

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SECURE CONNECTIONS  
FOR A SMARTER WORLD

PUBLIC

# Wireless Connectivity Landscape

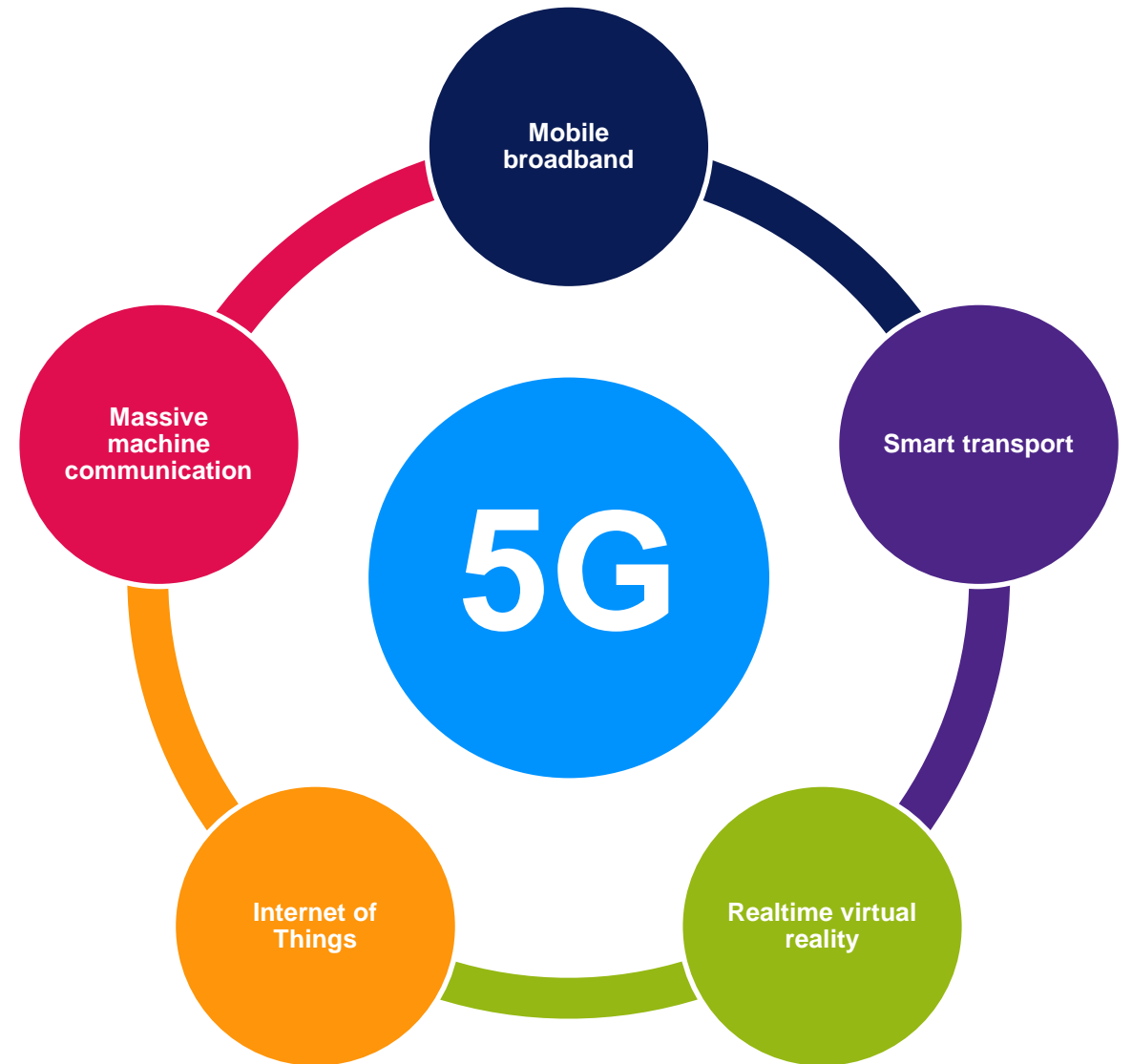
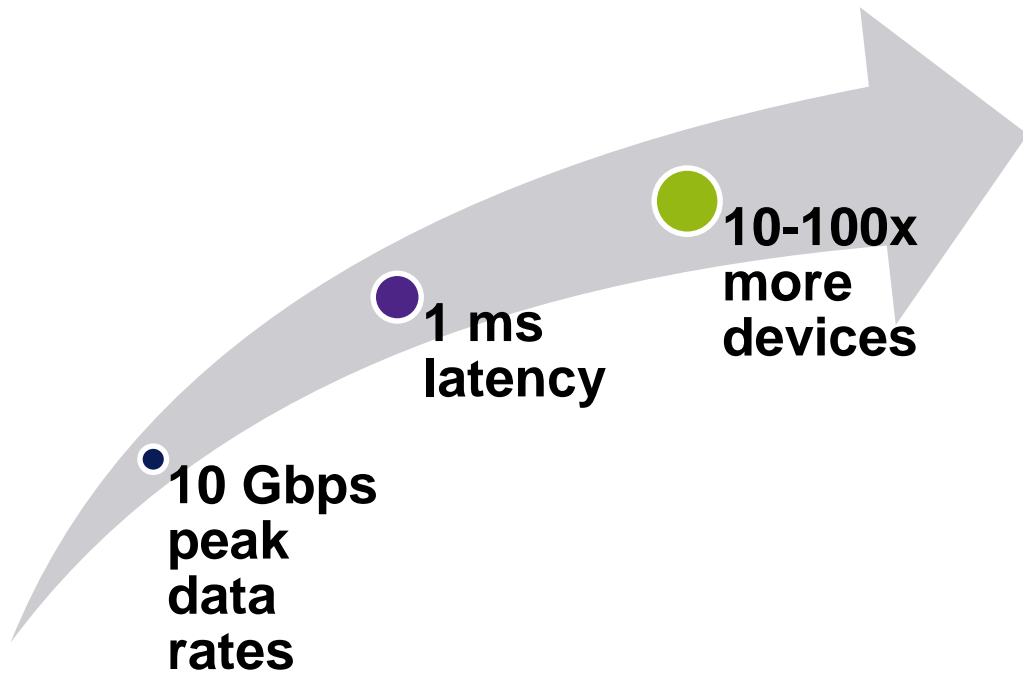


5G

CAT-M1

NB-IoT

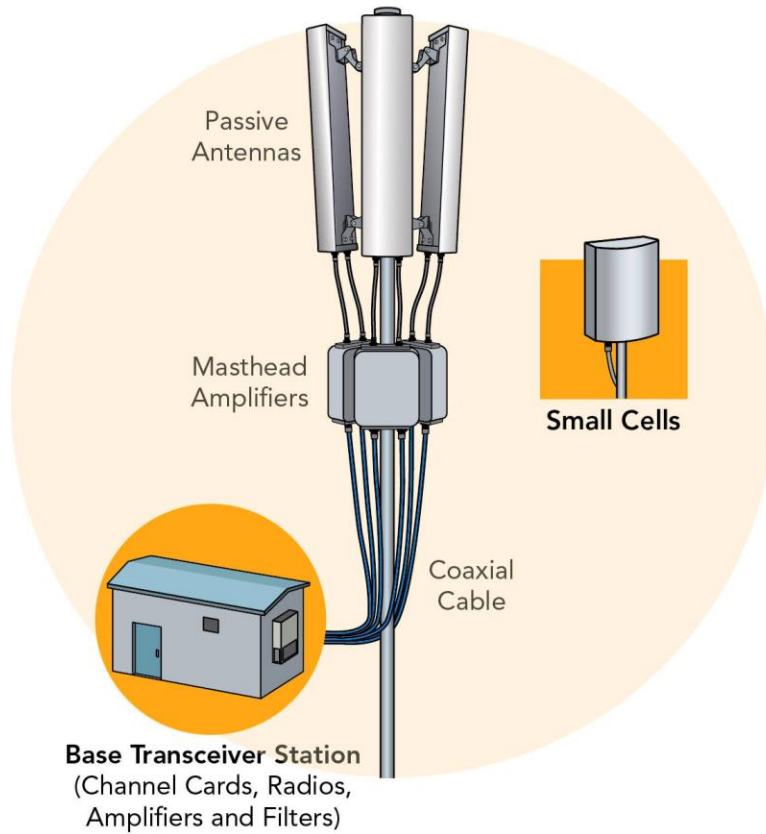
# The Road to 5G



# Evolution of the Cellular Base Station

## THE PAST

### Conventional BTS

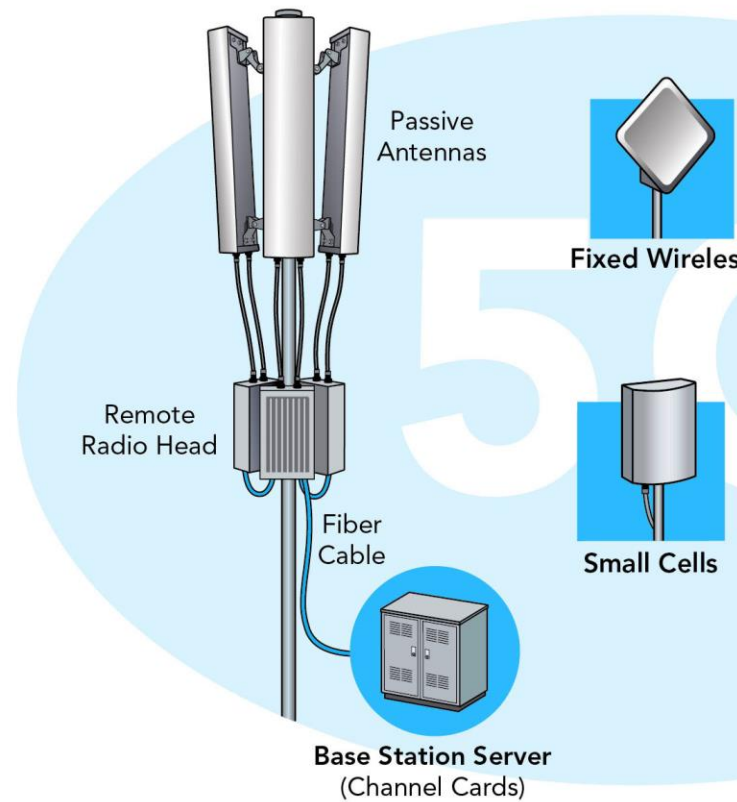


700 MHz

2.7 GHz

## 5G SOLUTIONS

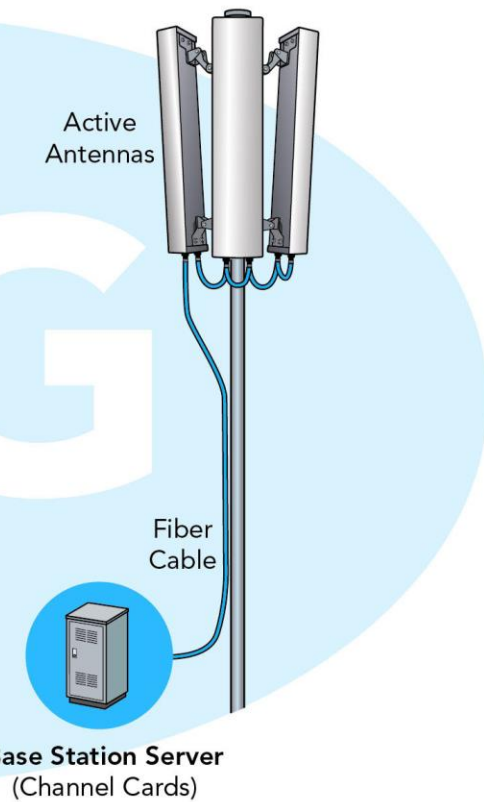
### Remote Radio Head



600 MHz

6 GHz

### Active Antenna Systems

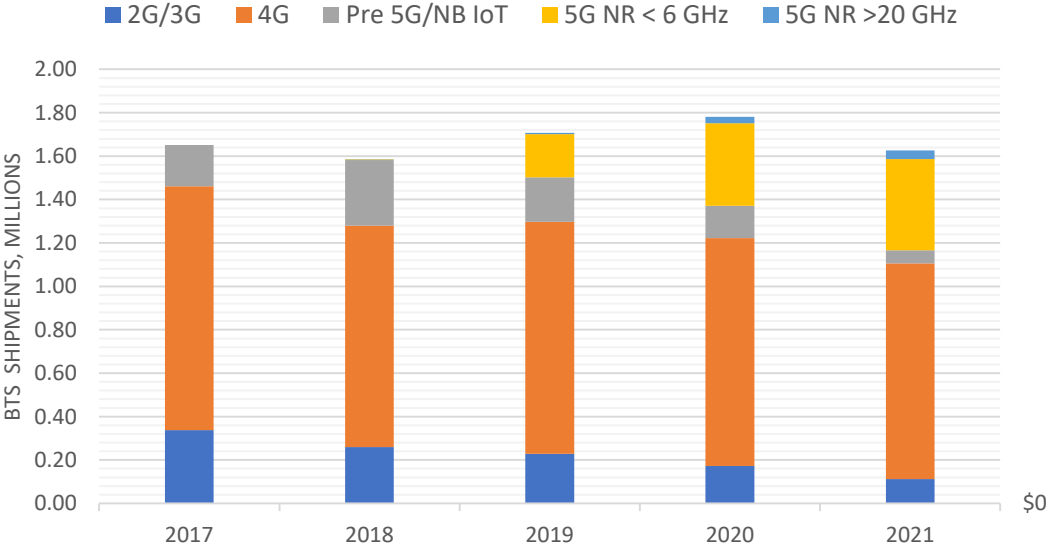


26-29 GHz

37-40 GHz

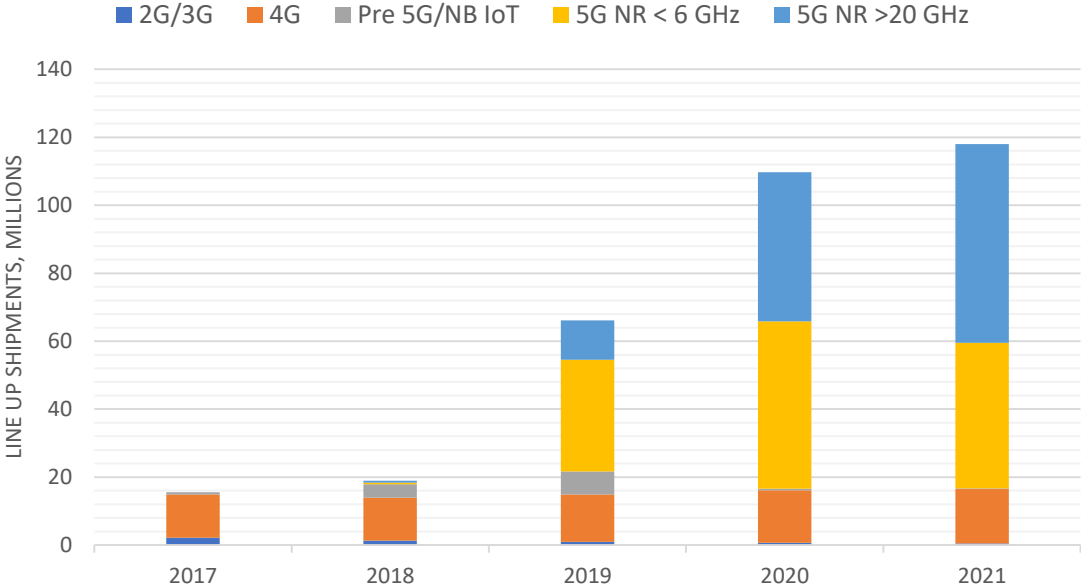
# 5G Market Trends: Expert Opinion (from Mobile Experts)

BTS Shipments



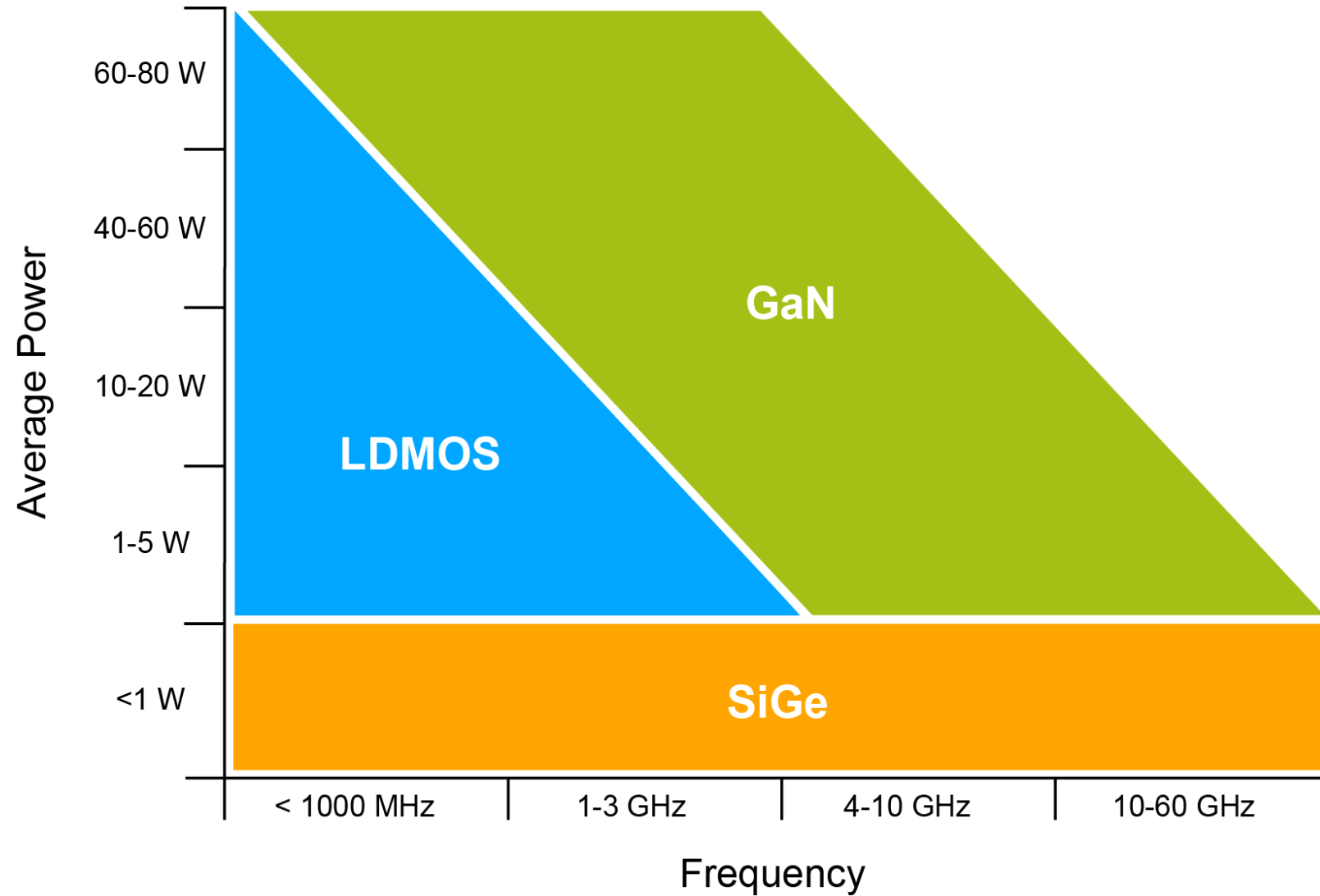
- Transmit and Receiver lineups will grow significantly due to Massive-MIMO deployments for both sub-6 GHz and mmWave

Line up Shipments



- Base Station Deployments remain relatively flat in the coming years

# RF Technology Toolbox

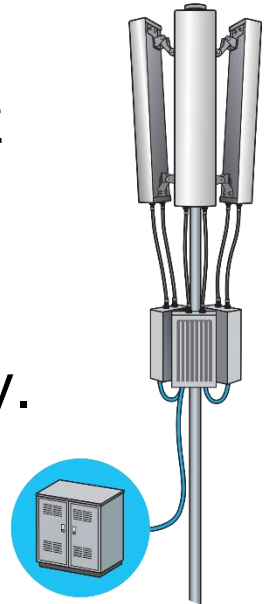


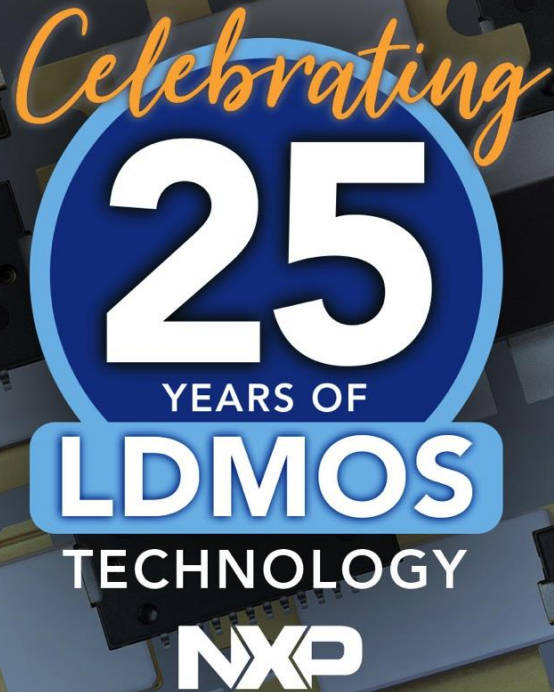




## Traditional Macro Focus

- Macro base stations have been the workhorse of the cellular infrastructure industry for years.
- Remote Radio Heads provide wide coverage in traditional frequency bands from 700 MHz to 3.8 GHz.
- Traditional 2T to 8T approach will struggle to improve capacity.





## Our History of LDMOS Innovation

- Traditional base stations have been powered by LDMOS transistors for the past 25 years.
- Single band solutions from 10W to 1kW peak powers will continue to be enabled by this dominant technology.





## GaN Enables Next Gen

- Gallium Nitride technology, with high frequency capability and increased power density enable higher frequency, wider band and more compact solution.
- Multi-band 5G deployments along with high efficiency compact solutions are enabled by GaN solutions.

# Example GaN Solutions

- 600 MHz to 6 GHz
- FDD and TDD ready
- Up to 7% more efficiency vs. leading LDMOS
- Single package Doherty solution for high power BTS

A3G22H400-04S



48 V GaN Doherty In-package

Doherty Performance @ 8 dB OBO

Frequency (MHz)	Gain (dB)	Efficiency	Peak Power (dBm)
1805-2200	14.9	56.5%	56.1

A3G18H500-04S



48 V GaN Doherty In-package

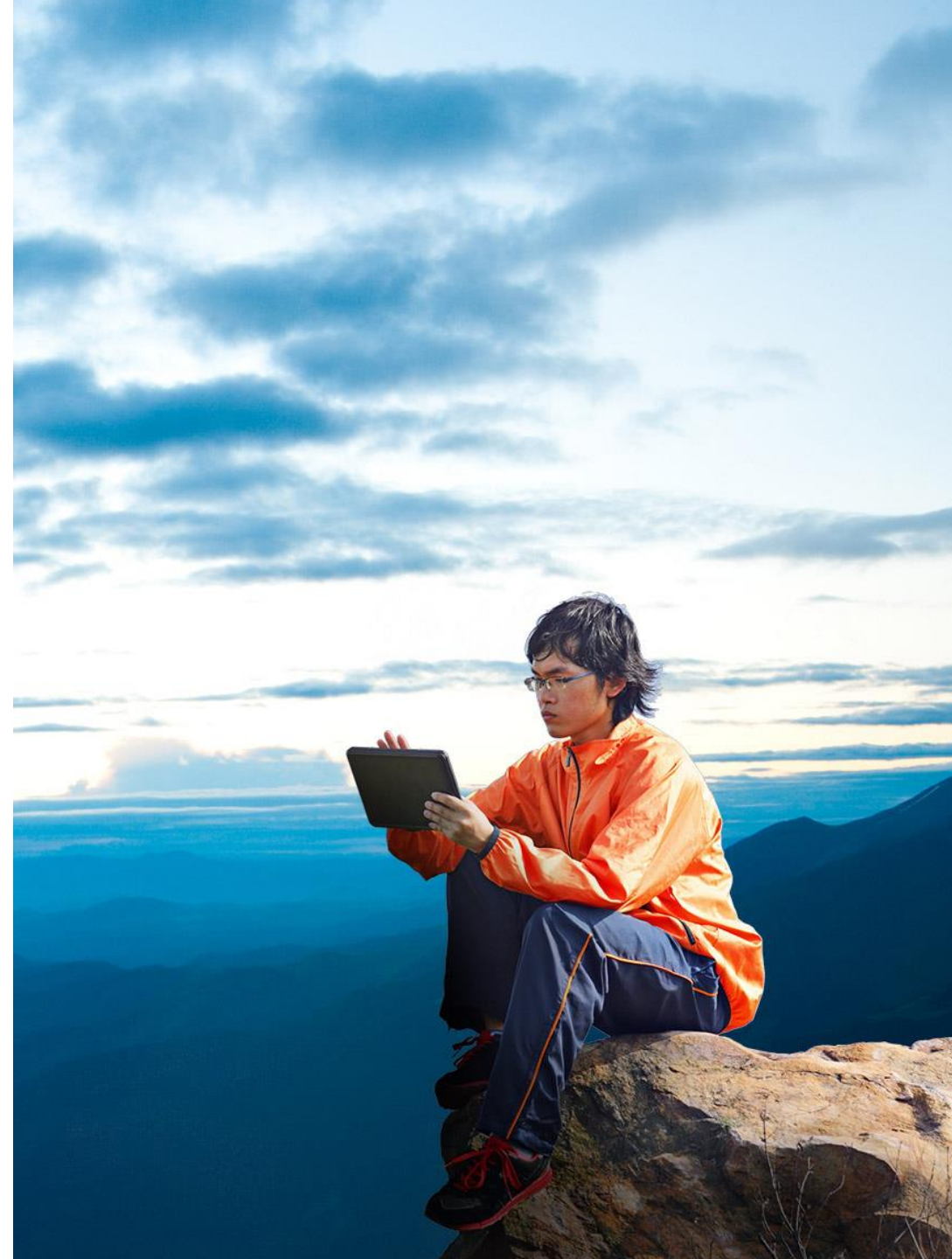
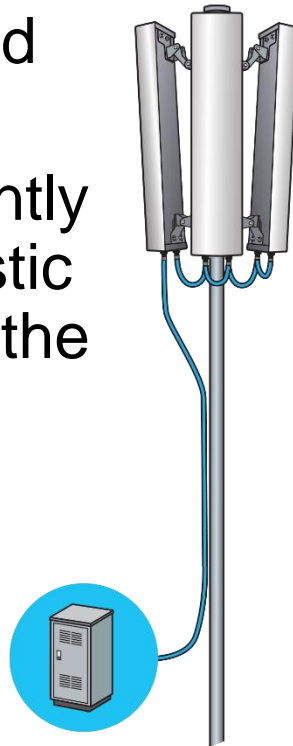
Doherty Performance @ 8 dB OBO

Frequency (MHz)	Gain (dB)	Efficiency	Peak Power (dBm)
1805-1880	16	54%	57.4

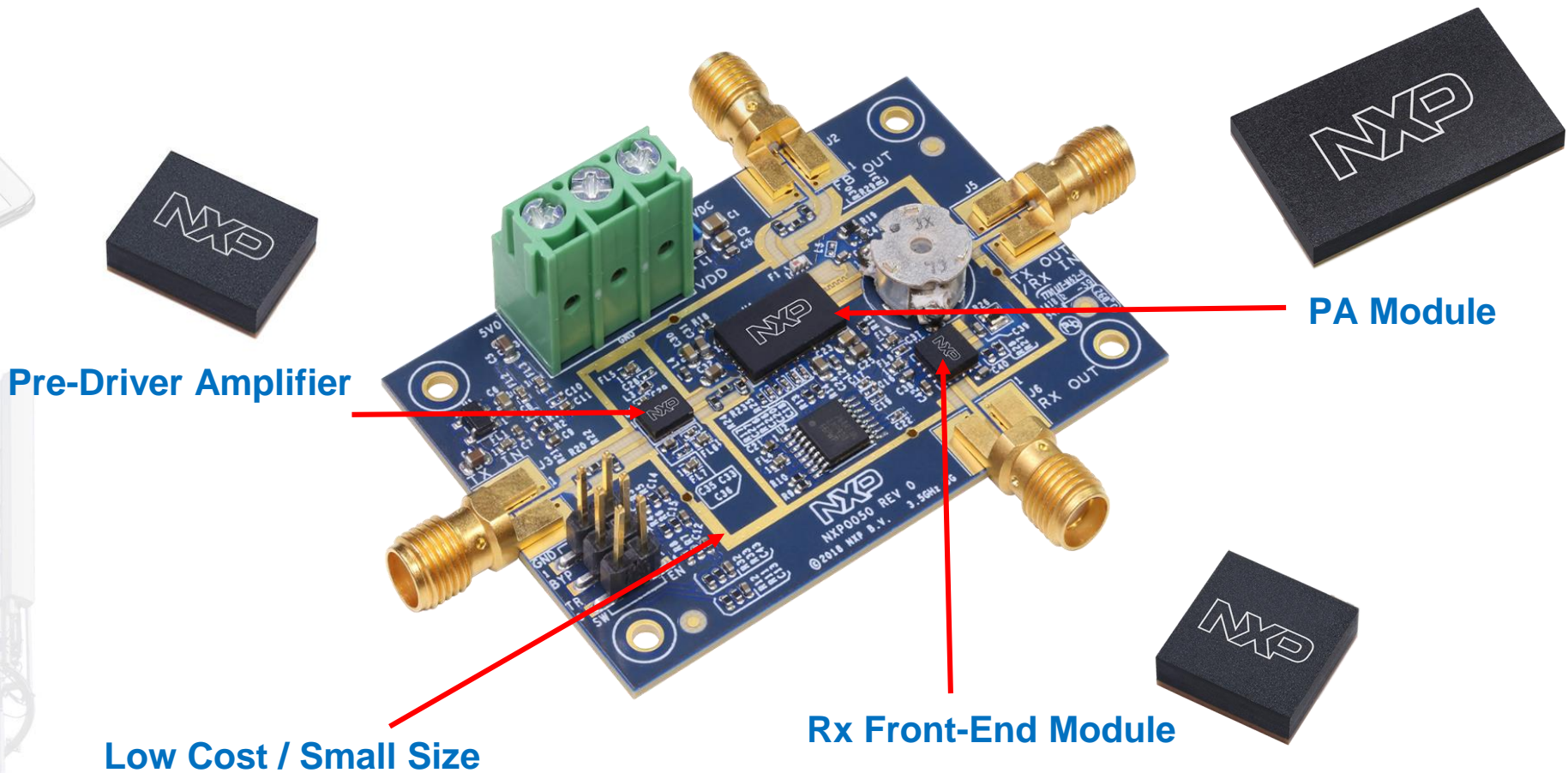


# Massive MIMO

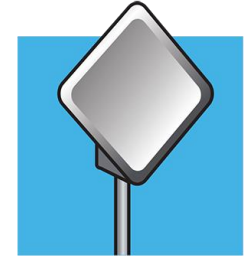
- Active Antenna Solutions enable a leap in capacity by utilizing between 16 and 64 transmit and receive paths in a single active system.
- TDD-mMIMO systems are leading the way at 2.6 GHz and 3.5 GHz bands but will expand to FDD and other frequencies as well.
- Although system costs are currently higher than traditional RRH, drastic throughput improvements justify the investment.



mMIMO systems require a new family of fully integrated high efficiency power amplifiers







## mmWave Solutions

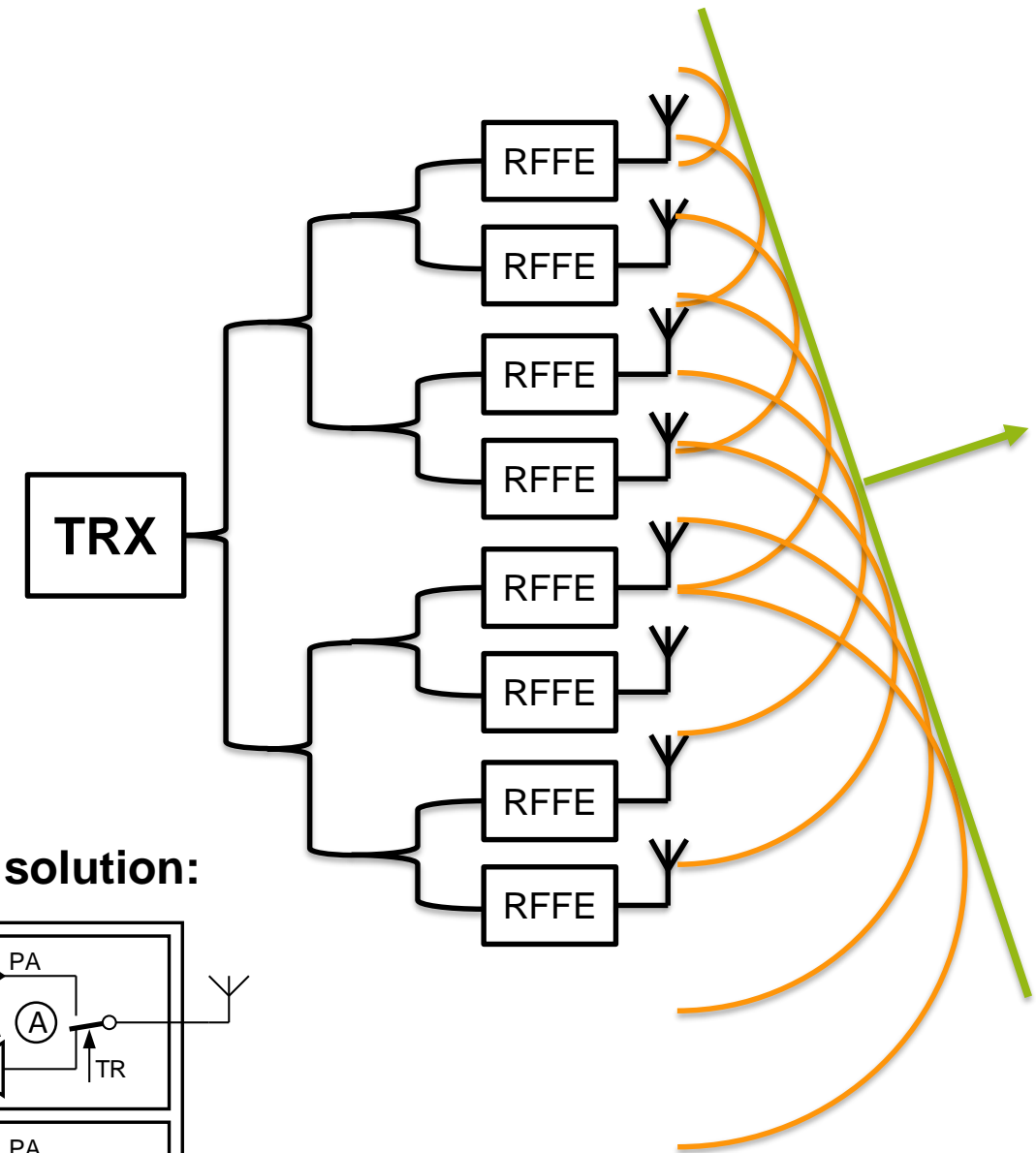
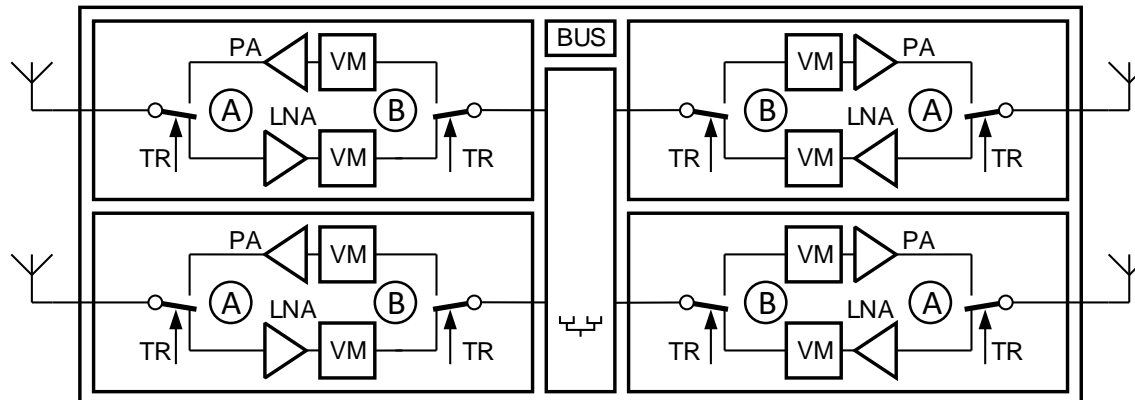
- To improve capacity even further, the industry is looking to mmWave frequencies ranging from 24 GHz to 39 GHz, enabling over 1 GHz of bandwidth.
- Beamforming will enable spatial multiplexing for increased spectrum reuse.
- Solutions include Fixed Wireless Access as well as Radio Access Networks.

# Solutions for mmWave beamforming

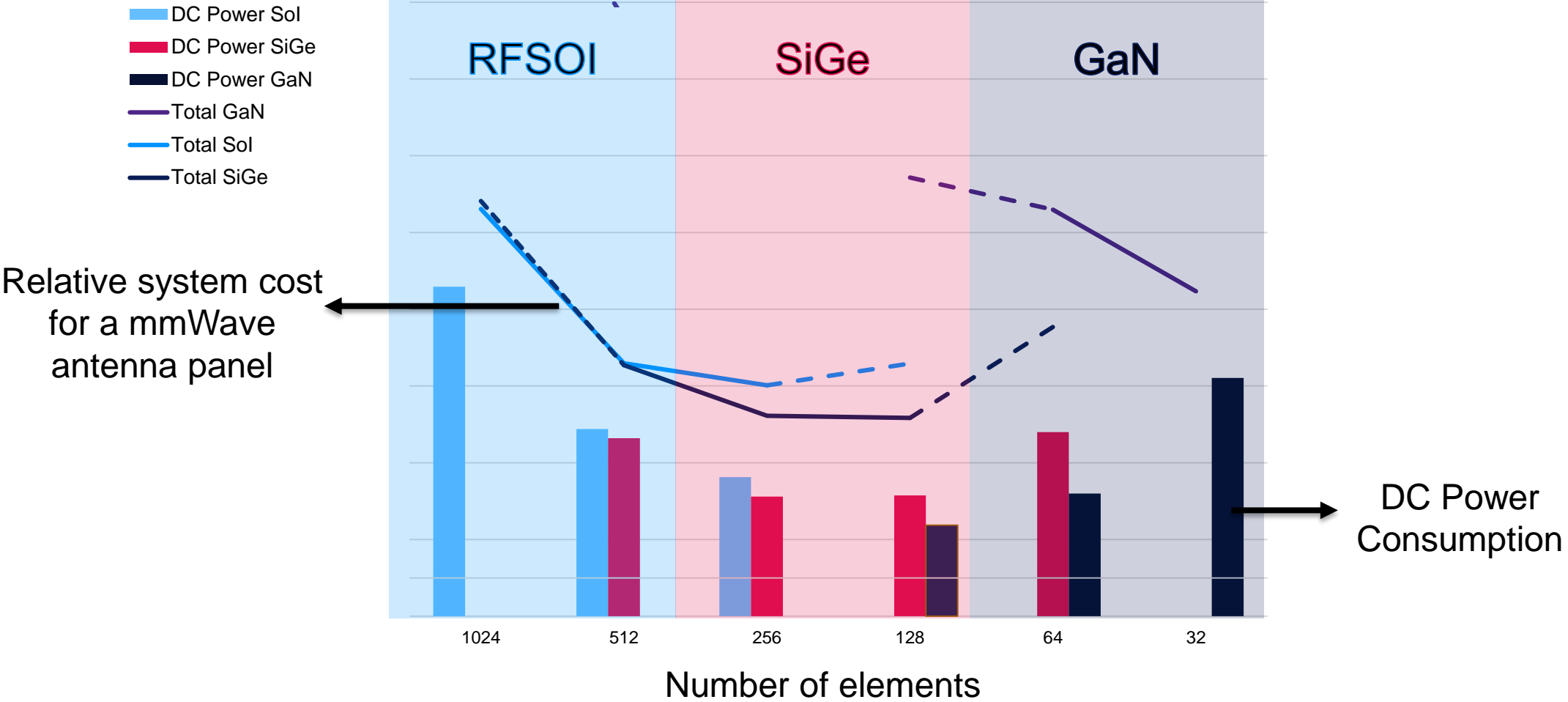
Required RF building blocks for a mmWave TDD beamforming system:

- Splitter / combiner network
- TX front end (PA)
- RX front end (LNA)
- TX / RX switch
- Phase shifter

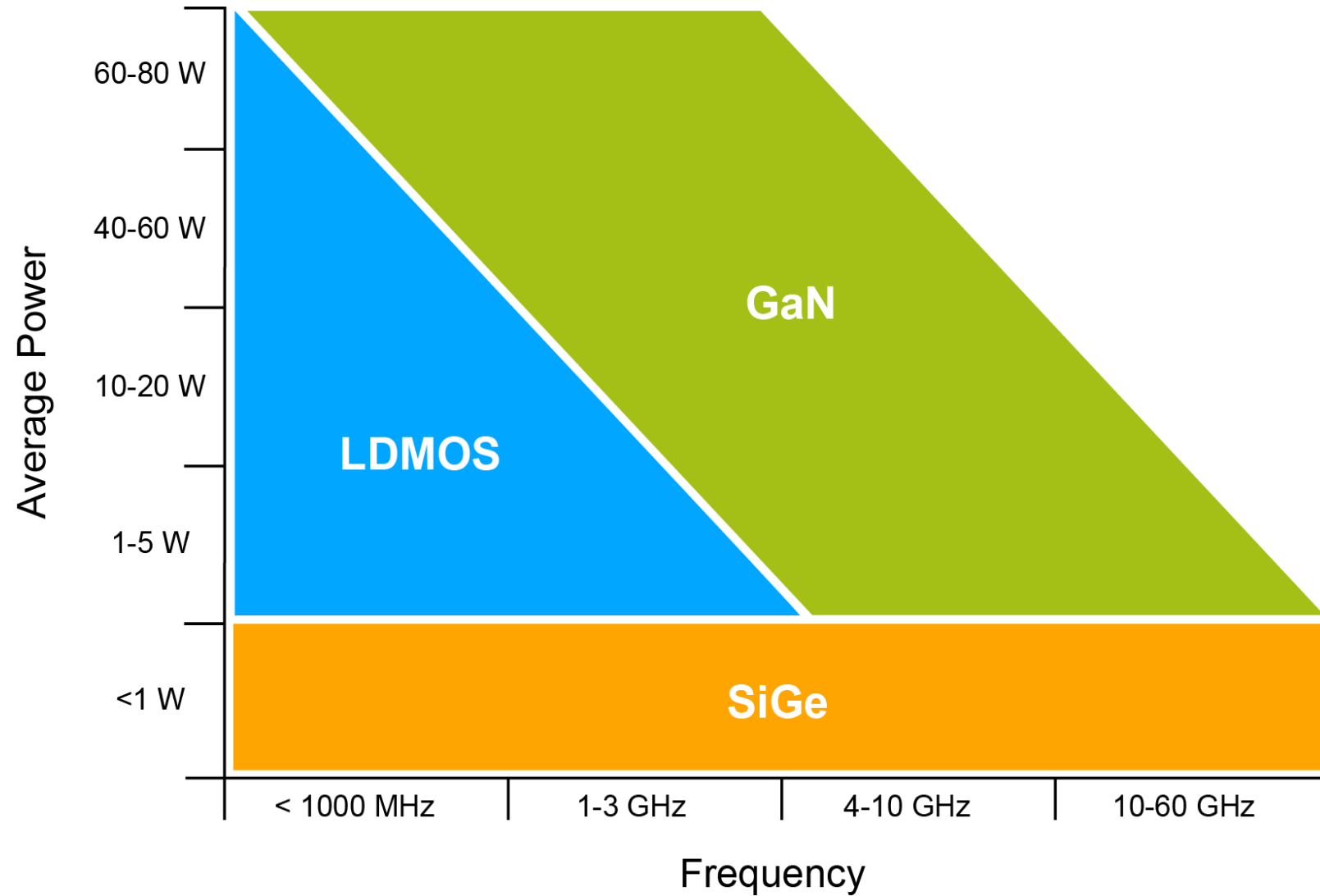
**Example of an integrated 4 channel solution:**



# SiGe has the sweet spot in both cost and power consumption



# NXP's RF Technology Toolbox







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Q & A